

AN EVALUATION OF THE EFFICACY OF CONTINUOUS 3 IN 1 BLOCK IN PROVIDING PAIN RELIEF FOR TRAUMA PATIENTS WITH FRACTURE FEMUR.

A STUDY OF 40 CASES

**Dissertation submitted for Doctor of Medicine
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INTRODUCTION

The techniques of peripheral neural blockade were developed early in the history of anaesthesia. The Anaesthesiologists play an important role in the trauma care. The Anaesthesiologist have extended their workplace from operation theatre to many Offsites like Emergency Room, MRI room etc. In many countries Anaesthesiologists have wider roles in trauma care ranging from prehospital care, resuscitation, pain relief and anaesthesia to postoperative care in an intensive care or high dependency unit.

Anaesthesiologists are very skilled in performing variety of nerve blocks which can be used to providing pain relief in the stressed trauma patients with very little interference on the hemodynamics. These nerve blocks not only provide compassionate pain relief to the patients but also avoid the deleterious effects of pain on the cardiovascular system and metabolic response of pain.

Fracture femur is very common in the elderly age group patients following trivial injury and also form a substantial part of patients admitted in the Trauma ward. These patients have number of co-morbid conditions which make them susceptible to the deleterious effects of pain due to the traumatic injury.

The inguinal paravascular 3 in 1 block of lumbar plexus can be used effectively to provide good pain relief and avert the deleterious effects of pain in these elderly group of patients. It ascertains the role of Anaesthesiologists in providing pain relief in the Trauma Setup.

AIM

To evaluate the efficacy of continuous 3 in 1 block in providing pain relief for trauma patients with fracture femur.

HISTORY

1. **“The Doctrine of specific energies of the senses”** –proclaimed by **Johannes P.Mueller** in **1826** stated that it is the nerves that determine what the mind perceives which opened up a new field of scientific thought & research into nerve function.
2. Theory by **Moritz.S.Schiff** in **1858** claimed pain as a separate and distinct sense.
3. In **1845 on 3rd June** **Sir France Rynd**, appointed surgeon to Meath hospital- delivered morphine solution to a nerve for relieving intractable neuralgia- solution delivered by means of gravity through cannula.
4. First use of syringe and hypodermic needle in **1855** by **Alexander wood**.
5. **Carl Koller**, an intern at ophthalmologic clinic at university of Vienna gave topical anaesthesia with cocaine on **September 11,1884** for glaucoma correction.
6. In **1884- William Stewart Halsted** performed first documented brachial plexus anaesthetic under direct vision at John Hopkins.
7. In **1911- Hirschel & Kulenkompff** performed first percutaneous Axillary & supraclavicular brachial plexus blocks.
8. **Victor Pauchet** in **1914** published the textbook for regional anaesthesia-**“L’Anesthesie Regionale”**, first book of its kind.

9. **Gaston Labat**- trained under Pauchet in France-in **1922** published the first edition of “Regional anesthesia-techniques & clinical applications”.
10. In **1923**- **AMERICAN SOCIETY OF REGIONAL ANESTHESIA** was founded.
11. Continuous peripheral nerve block with catheters was first performed in 1946.
Angboro did the first continuous brachial plexus block in **1946**.
12. In **1973**- **Montgomery Raj** first used Nerve stimulator in clinical practice.
13. **Winnie AP, Ramamurthy S, Durrani Z** in **1973** used the inguinal paravascular approach for lumbar plexus block called the “3 in 1” block.
14. **Rosenblatt** was the first to use catheter to provide continuous femoral nerve block for lower limb surgeries.

THE ROLE OF ANAESTHESIOLOGIST IN TRAUMA CARE

Anaesthesiologists can provide continuity of care from pre-hospital phase- Emergency Room- Operation Room to the Intensive care unit. Hence they are the right person to be involved in the trauma care in various stages namely,

- 1) Prehospital care
- 2) Inhospital trauma patient resuscitation
- 3) Trauma team leader
- 4) Provision of analgesia

- 5) Anaesthesia in Operation Room
- 6) Pre & postoperative critical care
- 7) Attending physician for transfer of trauma patient.

PRE-HOSPITAL CARE:

An effective Emergency Medical Service system should have short response time, adequately trained individuals and full support of communication and hospital facilities. They should have trained individuals in basic airway management, cervical spine control and shock advisory defibrillation. Hence the Anaesthesiologists are of value here.

INHOSPITAL TRAUMA RESUSCITATION:

Anaesthesiologists have their role in airway management and ventilatory strategies for the trauma patients. They also serve good in the management of circulatory shock and skilled in obtaining intravenous access.

ADVANCED TRAUMA LIFE SUPPORT:

Initial management of patients with major injuries during the Golden Hour is very important and the crucial factor in determining the morbidity and mortality of the trauma victims which is best done by Anaesthesiologists than anyone else.

TRAUMA TEAM LEADER:

Anaesthesiologists serve as the trauma team leader in coordinating the activities of the rest of the trauma team.

PROVISION OF ANALGESIA:

Analgesia is part of the resuscitation process. Pain relief not only provides compassionate relief to the patient but also ensures cardiovascular stability and subsequent improved organ & tissue perfusion thereby improving the overall outcome.

ANAESTHETIST IN OPERATION ROOM:

Anaesthesiologists serve a very important role in providing anaesthesia for trauma patients who require emergency surgery.

PRE & POST OPERATIVE CRITICAL CARE:

As severely injured trauma patients require multiorgan support like ventilatory support, inotropic support, renal replacement therapy etc these patients are best managed in critical care setup under the supervision of Anaesthesiologists.

TRANSFER OF TRAUMA PATIENTS:

Anaesthesiologists serve also as attending physician in transport of critically ill patients from primary hospital to specialized referral centres.

Thus the role of anaesthesiologists in the trauma set up is very important for its successful functioning.

THE EFFECTS OF PAIN IN TRAUMA PATIENT:

The confluence of hormonal, immunologic, cardiovascular, metabolic and inflammatory response after major trauma results in surgical stress response, the primary purpose of which is to restore and maintain cellular homeostasis.

MECHANISM OF PAIN:

1. Hypothalamic pituitary adrenal axis:

Pain is carried by afferent sensory nerve fibers and transmitted to spinal cord from which it is relayed to the hypothalamus and the efferent response is effected through peripheral nerves and to the adrenals.

2. Sympathomedullary adrenal axis:

The sympathomedullary adrenal axis is involved in the release of mediators like catecholamines involved in the regulatory effect on cardiac output and regional circulation.

3. Lymphoadrenal axis:

It is involved in the release of ACTH by lymphocytes.

BIOCHEMICAL RESPONSE TO PAIN:

The biochemical response to pain can be classified as

1. Endocrine response.
2. Metabolic response.

ENDOCRINE RESPONSE TO STRESS:

The endocrine response is mediated by the release of counter regulatory hormones like ACTH, CORTISOL, ADH, GH & CATECHOLAMINES & Inflammatory mediators like IL-2. These lead onto clinical manifestations like hypertension, tachycardia, arrhythmia, protein catabolism, immune suppression, hypercoagulability and increased O₂ consumption. The release of vasopressin and aldosterone leads to water and salt retention. Catecholamines leads to hypertension, tachycardia, arrhythmias, gluconeogenesis, glycogenolysis and Glucagon leads to gluconeogenesis and ketogenesis.

METABOLIC RESPONSE TO STRESS:

The metabolic response to stress is due to release of counter regulatory hormones which leads on to the following effects,

Increased lipolysis and ketogenesis

Increased muscle lipolysis

Increased acute phase proteins

Increased gluconeogenesis and glycogenolysis

Insulin resistance

Increased lactate production in skeletal muscle.

CLINICAL EFFECTS OF PAIN

Pain response can be divided clinically into two distinct phases namely,

1. “ebb-phase”- immediate phase- related to hypovolemia
2. “flow phase” – chronic hyperdynamic phase.

“Ebb phase”- is characterized as transient hypometabolic state related to hypovolemia and decreased tissue perfusion due to alpha mediated vasoconstriction. This phase presents as hypothermia, oliguria and decreased O₂ utilization with either increase or decrease in cardiac output. There is also increased release of stress hormones during this phase.

“flow phase” is the chronic hyperdynamic phase which lasts for 2-5 days after trauma which is characterized by increased cardiac output and beta mediated increase in organ blood flow along with increased O₂ consumption due to hypermetabolic state.

This hypermetabolic state is attributed to protein catabolism, lipolysis, gluconeogenesis, glycogenolysis and increased body temperature. Inadequate control of nociception during this phase leads to higher morbidity and mortality because of immunosuppression, increased myocardial O₂ consumption leading on to Myocardial Infarction, increased thrombogenicity due to hypercoagulable state, decrease body mass & tissue reserve as well as impaired pulmonary function.

Also tissue trauma leads to release of algescic agents like serotonin, bradykinin, hydrogen ions, potassium ions, PGs into local regions which excite primary afferent fibers to heighten responsiveness to any stimulus resulting in unexpected firing of neurons.

Primary injury phase leads onto the inflammatory phase with the release of inflammatory mediators like cytokines, purines, leucotrienes, neuropeptides, nitric oxide and nerve growth factors in the region of tissue injury which leads to a persistent input to spinal cord beyond the initial insult and maintain pain patterns in the post injury phase.

PREVENTION OF STRESS RESPONSE TO PAIN:

The alleviation of pain leads to blockade of stress related sympathetic activation which has the following beneficial effects-

Decreased cortisol levels,
Decreased Noradrenaline levels,
Decrease in serum glucose to normal levels,
Decreased protein catabolism,
Decreased hypercoagulability,
Decreased cardiovascular response &
Decreased incidence of Infections.

BENEFITS OF REGIONAL ANAESTHESIA IN TRAUMA:

The advantages of regional anaesthesia in trauma patients include

1. suppression of stress response
2. decreased blood loss
3. decreased incidence of venous thromboembolism
4. increased peripheral vascular circulation
5. improved gastrointestinal function
6. supplementation to general anaesthesia
7. increased pulmonary efficiency
8. provision of postoperative analgesia
9. improved mental status.

ANATOMICAL CONSIDERATIONS

ANATOMY OF LUMBAR PLEXUS

Lumbar plexus lies deep in the psoas major muscle in front of the transverse processes of lumbar vertebrae.

It is formed by – ventral rami of first three lumbar nerves

- greater part of ventral ramus of fourth

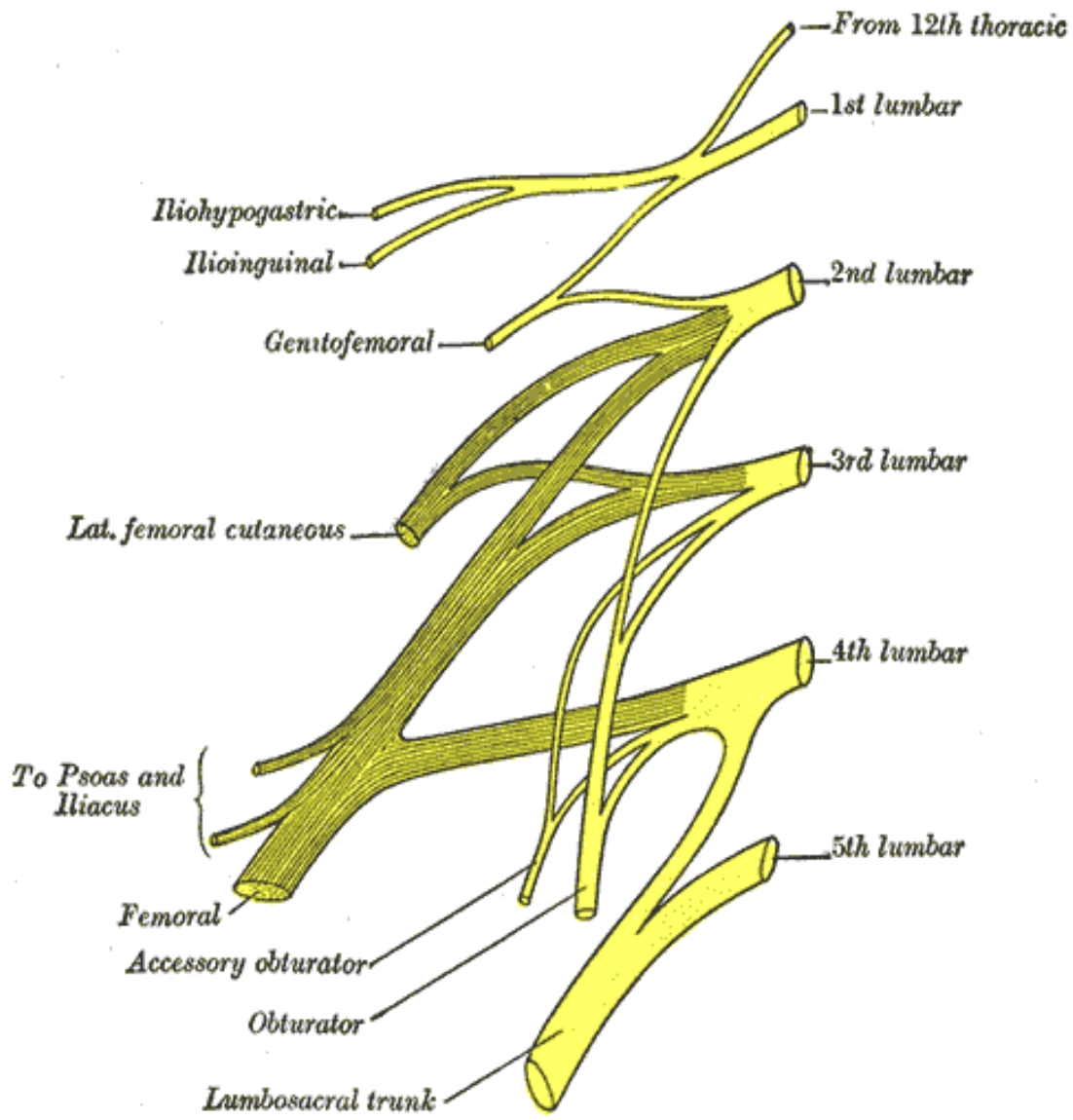
lumbar nerve.

All the branches of plexus emerge from substance of psoas major muscle.

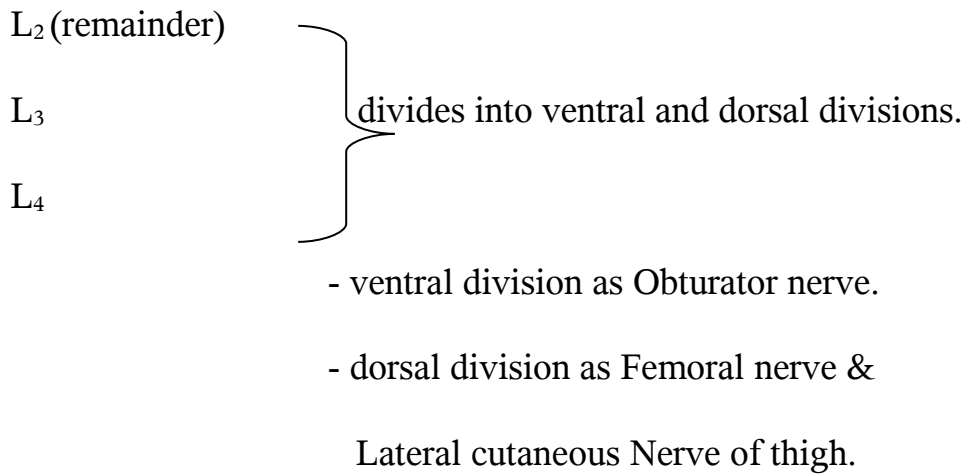
L₁ – frequently supplemented by T₁₂ – divides into upper and lower branch.

Upper branch gives Ilioinguinal & Iliohypogastric nerves.

Lower branch unites with L₂ to form Genitofemoral nerve.



LUMBAR PLEXUS AND ITS BRANCHES



RELATIONS OF LUMBAR PLEXUS AND ITS BRANCHES:

Lumbar plexus forms within or passes through the space between quadratus lumborum and psoas major muscle. At this point the nerves lie within the compartment formed by the fascia of these muscles.

Branches:

Lateral cutaneous nerve of thigh – leaves medial border of psoas major at its midpoint to enter lateral thigh at a very superficial level.

Obturator nerve- leaves medial border of psoas major and enter medial thigh at a very deep level.

Femoral nerve – the largest branch of plexus, appears at the lateral margin of psoas major muscle and remains in the groove between psoas major and iliacus muscle.

Above the inguinal ligament

Femoral nerve is bound Laterally &

Posteriorly by iliac fascia

Medially by psoas fascia

Anteriorly by transversalis fascia

Below the inguinal ligament

Femoral nerve bound posterolaterally by iliopsoas fascia

Medially by iliopectineal fascia

Anteriorly by fascia lata.

As seen in the image, femoral nerve lies beneath both fascia lata and fascia iliaca but femoral artery lies above the fascia iliaca. Hence both artery and nerve are not in the same plane.

It may seem that unlike brachial plexus, branches of lumbar plexus are spread wide apart and it is impossible to group the nerves into single compartment.

But when closely observed it would be clear that all the nerves will be arranged between the iliac and psoas fascia. Thus when accessed to the iliopsoas fascia by paravascular approach of femoral nerve, all the branches of lumbar plexus can be blocked similar to the plexus block for upper limb. Based on this concept the continuous block of lumbar plexus is achieved.

VARIOUS APPROACHES OF LUMBAR PLEXUS:

1. PARAVERTEBRAL APPROACH
2. INGUINAL PARAVASCULAR APPROACH
3. ILIACUS APPROACH

INGUINAL PARAVASCULAR BLOCK (3 IN 1 BLOCK):

The inguinal paravascular approach of lumbar plexus is employed to block three nerves namely Femoral Nerve, Lateral cutaneous nerve of thigh and Obturator nerve. As all these three nerves lie beneath the fascia iliaca, these nerves can be easily blocked by injecting local anaesthetic in that plane.

As femoral artery pulsation is felt prominently below the inguinal ligament, femoral nerve can be identified lateral to the femoral artery by three techniques.,

1. with the help of nerve stimulator- when the needle tip is near the nerve it will produce contraction even with 0.5mA
2. by directly eliciting the paraesthesia.
3. by fascial clicks- with the help of short bevel needle two distinct popoff could be elicited when piercing the fascia lata and fascia iliaca.

Use of nerve stimulator yields high success rate but the cost of equipment is high. Elicitation of paraesthesia may lead to direct injury of the nerve. Double popoff method can be made successful with good expertise.

Blockade of femoral nerve provides analgesia to anterior thigh, knee,

medial aspect of calf, ankle and foot. Blockade of lateral cutaneous nerve of thigh provides sensory loss to lateral aspect of thigh and blockade of obturator nerve blocks medial aspect of thigh. Only the posterior aspect of thigh escapes the sensory block with the “3 in 1” block.

FRACTURE FEMUR:

Fracture femur is one of the most common cause for admissions in the trauma unit. It is one of the most common fractures occurring in elderly people that can occur even with trivial injuries.

These elderly individuals already have diminished organ reserves and when these patients sustain major injury like femur fracture it not only disables them but also starts the downhill course to death.

This attempt to provide pain relief for fracture femur cases through the lumbar plexus block helps to improve the outcome of these debilitated patients due to the attenuation of stress response to pain and providing compassionate pain relief to these patients.

In fracture femur, the pain is in the region of thigh which is supplied by the lateral cutaneous nerve of thigh, branches of femoral nerve – the medial and intermediate cutaneous nerve of thigh, the obturator nerve and the posterior cutaneous nerve of thigh-a branch of sciatic nerve.

By inguinal paravascular approach of lumbar plexus, femoral nerve, lateral

cutaneous nerve of thigh and obturator nerve are the common nerves that are blocked. Hence this block is sufficient to provide pain relief in fracture femur cases.

PHYSIOLOGICAL CONSIDERATIONS

Pain is an extraordinarily complex sensation which is difficult to define and equally difficult to measure in an accurate objective manner. The sensory appreciation of affective nociceptive stimulation elicits an affective or autonomic component; both are subjected to rational interpretation by the patient. The sensation of pain differs among individual patients, the emotional component may vary according to patients' psychological composition and the rational component varies with the patients' previous experience, insight and motivation.

The International Association for the study of Pain has defined pain as “an unpleasant sensory and emotional experience associated with actual or potential tissue damage or described in terms of such damage”. Surgery and trauma produces local tissue damage with consequent release of algescic substances (prostaglandins, histamine, serotonin, bradykinin, substance P).

Types of pain

There are two qualitatively different types of pain

- a) Fast pain is a short, well localised, stabbing sensation that is matched to the stimulus, such as surgical incision. Fast pain results from stimulation of myelinated type A- delta nerve fibres with conduction velocities of 12-30 m/s.
- b) Slow pain is characterized as a throbbing, burning, or aching sensation that is poorly localized and less specifically related to the stimulus. This pain may continue long after the removal of the stimulus. Slow pain results from stimulation of more primitive, unmyelinated type C nerve fibres with conducting velocities of 0.5 to 2.0m/s.

It is the immediate, stabbing pain that instantly tells the person that tissue damage is occurring; where as burning pain becomes the source of sustained discomfort.

Pain receptors

Pain receptors are naked, afferent nerve endings of myelinated A- delta and unmyelinated C fibres. These receptors transduce mechanical, thermal or chemical stimuli into action potentials.

First order neurons

Pain signals are transmitted from pain receptors along myelinated A-delta fibres and unmyelinated C fibres and terminate on cells in the dorsal horn.

Anatomically A-delta fibres synapse with cells in laminae 1 and 5 of the dorsal horn, whereas C fibres synapse with cells in laminae 2 and 3, which is also known as the substance gelatinosa.

Second order neurons

Cells in laminae 1 and 5 of spinal cord are spinothalamic cells, and about 75% of fibres originating from these cells cross to the contralateral spinothalamic tract.

Near the thalamus, the spinothalamic tract divides into a lateral portion often called the neospinothalamic tract, and a medial portion called the paleospinothalamic tract.

The phylogenetically newer portion of the spinothalamic tract projects to the posterior portions of the thalamus and is considered to be involved in the spatial and temporal aspects of pain perception.

The phylogenetically older portion of the spinothalamic tract projects to the medial thalamus and is responsible for the initiation of unpleasant aspects of pain as well as autonomic responses to pain. The paleospinothalamic tract has numerous synapses with the reticular formation of the brainstem, the medial thalamus, the periaqueductal grey matter, and the hypothalamus.

Other pathways involved in cephalad transmission of pain impulses include the spinocervical tracts, spinoreticular tracts and spinomesencephalic tracts.

Thalamic terminus

Most of the fibres of the spinothalamic tract terminate in the nucleus ventroposterolateralis(VPL), which is the major sensory relay nucleus. The other fibres terminate in the posterior group of nuclei that include nucleus

venterposteromedialis, intralaminar nuclei, ventrobasal complex, and hypothalamic nuclei.

Third order neurons

Projections from the thalamus end in three cortical areas, S1, S2 of the sensory cortex and the cingulate gyrus on the side opposite to the stimulus, the cingulate gyrus is involved in emotion, C fibres transmit burning and aching types of pain, which is consistent with the diffuse projection of these fibres from the thalamus into the limbic and subcortical areas. These signals also activate the reticular activating system.

Some descending neural pathways exert a modifying effect on incoming noxious input. That such sites existed was predicted by the gate control theory of pain. Many such sites, such as the periaqueductal gray matter, have high concentrations of endogenous opioid neurotransmitters. These areas project to the rostroventral medulla and, via the reticulospinal tracts and the dorsal lateral funiculus, to laminae 1,2 and 5. Other neurochemicals like norepinephrine and serotonin are implicated in these inhibitory/ modulatory circuits.

PHARMACOLOGICAL CONSIDERATIONS

BUPIVACAINE

Bupivacaine is an amide type local analgesic drug synthesized in 1957, and used clinically in 1963. The base is not very soluble but the hydrochloride readily dissolves in water. The pKa is 8.2. It is very stable both to repeated autoclaving and to acids and alkalis.

Bupivacaine is reputed to be four times as potent as both mepivacaine and lignocaine, so that a 0.5% solution is roughly equivalent to 2% lignocaine.

Protein binding	95%
Lipid solubility	28%
Volume of distribution	73 Litres
Clearance	0.47(litres/min)
Elimination halftime	210 mins

Pharmacodynamics

A. Mechanism of action

Local anaesthetics prevent transmission of nerve impulses by inhibiting passage of sodium ions through ion selective sodium channels in nerve membranes. Inhibition of sodium ion permeability slows the rate of depolarization such that the threshold potential is not reached and thus an action potential is not propagated. Block by local anaesthetics is more marked at higher frequencies of depolarization and with longer depolarizations.

B. Action on nerves:

1) Different types of nerve fibres differ significantly in their susceptibility to local anaesthetic blockade on the basis of size and myelination. Upon application of a local anaesthetic to a nerve root, the smaller B and C type fibres are blocked first. The small A delta are blocked next. Thus pain fibres are blocked first; other sensations disappear next; and motor function is blocked last.

2) Effect of firing frequency:

Block by local anaesthetics is more marked at higher frequencies of depolarization and with longer depolarization. Sensory fibres especially pain fibres have a high firing rate and a relatively long action potential duration. They are blocked sooner with low concentration of local anaesthetics than are the A alpha fibres.

3) Effect of fibre position in the nerve bundle:

In large nerve trunks, motor nerves are usually located circumferentially,

and for that reason they are exposed first to the drug when it is administered by injection into the tissue surrounding the nerve. In the extremities, proximal sensory fibres are located in the mantle of the nerve trunk, whereas the distal sensory innervation is in the core of the nerve, thus, during infiltration block of a large nerve, anaesthesia first develops proximally and then spreads distally as the drug penetrates the core of the nerve.

Pharmacokinetics

Absorption : systemic absorption of injected local anaesthetic from the site of administration is modified by several factors, including dosage, site of injection, drug-tissue binding, the presence of vasoconstrictor substances and the physicochemical properties of the drug.

Neuronal uptake of the drug is presumably enhanced by the higher local drug concentration. At the nerve fibre level, only a small fraction of bupivacaine penetrates the fibre. However the resulting functional block is proportional to the intraneural concentration.

Metabolism & Excretion: the principal metabolic pathway of bupivacaine is N-dealkylation. The other pathways are aromatic hydroxylation, amide hydrolysis, and conjugation. Only the N-dealkylated metabolite N-desbutylbupivacaine, has been measured in blood or urine after epidural or spinal anaesthesia. The mean total urinary excretion of bupivacaine and its dealkylation and hydroxylation metabolites account for

greater than 40% of the total anaesthetic dose. Alpha1 acid glycoprotein is the most important plasma protein binding site of bupivacaine and its concentration is increased in many clinical situations, including postoperative trauma.

Toxicity:

Systemic toxicity is due to excess plasma concentration of the local anaesthetic. Accidental intravascular injection of local anaesthetic is the most common mechanism for producing toxicity.

The typical plasma concentration of bupivacaine causing CNS toxicities like seizure is 4.5 to 5.5 mcgs/ml. The threshold plasma concentration at which CNS toxicity occurs may be related more to the rate of increase than the total amount injected.

The typical plasma concentration at which bupivacaine causes cardiotoxicity is 8-10 mcgs/ml. It may lead on to precipitous hypotension, cardiac arrhythmias and atrioventricular heart blocks.

REVIEW OF LITERATURE

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1. Fletcher AK, Rigby AS, Heyes FL of Rotherham General Hospital did a randomized controlled trial in the emergency department for patients with fracture neck of femur. Patients were randomly assigned to group 1.- 3 in 1 block with bupivacaine along with intravenous morphine and group 2- intravenous morphine alone. Pain scores were recorded at admission and at intervals till 24hrs period. Patients receiving 3-in-1 nerve blocks recorded a faster time to reach the lowest pain score: 2.88 hours in patients with nerve block and 5.81 hours in the control group. Nerve block recipients required significantly less morphine per hour than control patients (mean of 0.49 mg/h versus 1.17 mg/h). It was concluded that three-in-one femoral nerve block is an effective method of providing analgesia to patients with fractured neck of femur in the ED.

2. Haddad and Williams studied 50 patients with extracapsular femoral fractures admitted in Emergency Department. They were allocated into two groups one with femoral nerve block and systemic analgesia and other group with systemic analgesia alone. They used Visual Analog Scale to assess the pain during preblock period and at 15 min, 2h and 8h period after the block. The femoral nerve block group required

significantly less intramuscular opiate analgesia ($p < 0.05$). Thus it was concluded the femoral nerve block provides good pain relief with extracapsular femoral fractures.

3. **R Fournier, E Van Gessel, G Gaggero, S Boccovi, A Forster and Z Gamulin** of Department of Anaesthesiology, University Hospital of Geneva, Switzerland evaluated the efficacy of a single shot "3-in-1" femoral nerve block for prosthetic hip surgery in association with general anaesthesia on post-operative analgesia. Forty patients, ASA 1 to 3, received sham block or "3-in-1" femoral nerve block, following Winnie's landmarks with a nerve stimulator, and 40 ml bupivacaine 0.5% with epinephrine were injected after induction of anaesthesia. The time from performance of sham or "3-in-1" femoral nerve block to the first analgesic intervention (261 ± 49 min versus 492 ± 40 min, $P < 0.05$) and time from extubation to the first analgesic intervention (61 ± 44 min vs 298 ± 39 min, $P < 0.05$) was prolonged in the study group.

4. **ND Edwards and EM Wright** of Department of Anaesthesia, Morriston Hospital, Swansea, Great Britain investigated the value of a 3-in-1 nerve block, followed by a continuous low-dose infusion of bupivacaine into the femoral nerve sheath for postoperative analgesia after total knee replacement. Thirty-seven patients were randomly allocated to either a control group or a study group. The study group had a

catheter placed in the ipsilateral femoral nerve sheath. A 3-in-1 nerve block was then performed in the study group with injection of 30 mL of 0.25% bupivacaine through the catheter. This was followed by a continuous infusion of 0.125% bupivacaine at 6 mL/h. The study group had significantly lower pain scores at 4hrs and 24 hrs postoperatively (P less than 0.01) and required less postoperative opioid analgesic medication (P less than 0.01) than the control group. The authors conclude that a continuous low-dose infusion into the femoral nerve sheath results in better pain relief than conventional intramuscularly administered narcotics after total knee arthroplasty.

5. **Capdevila, Biboulet** of Department of Anesthesiology, University Hospital, Montpellier, France tested the effectiveness of bilateral continuous paravascular femoral nerve blocks in a patient following bilateral femoral shaft surgery in whom other analgesic regimens were considered contraindicated or of limited effectiveness. A continuous infusion of lidocaine, morphine, and clonidine was established in both femoral catheters preoperatively and used postoperatively as the principle source of analgesia. Radiographic contrast was used to document the position of both catheters and to document the spread of injectate. Visual analog scale (VAS) pain scores were recorded in the recovery room and at 4, 16, 24, 48, and 72 hours postoperatively. Plasma lidocaine levels were determined by gas chromatography at 4, 16, and 48 hours postoperatively. Sensory assessment in the

distribution of the femoral, lateral cutaneous, and obturator nerves was performed to confirm the presence of sensory blockade. Pain scores at rest were consistently rated good to excellent (VAS < 20 mm). Evidence of sensory conduction block was present throughout the infusion. Plasma concentrations of lidocaine were consistently below toxic levels (1.35 to 1.65 micrograms/ml). It was concluded that bilateral continuous femoral paravascular nerve blocks can be used to provide effective and safe analgesia in patients requiring aggressive analgesia in whom other techniques may be contraindicated.

6. **Snoeck, Vree** of Department of Anesthesiology, Canisius Wilhelmina Hospital, Nijmegen, NL studied plasma concentrations and safety of 2 mg/kg bupivacaine in a femoral "3-in-1" nerve block in patients older than 80 years of age.

A 3-in-1 femoral nerve block, combined with a general anesthetic was used in 10 elderly patients aged over 80 years. They were undergoing emergency surgery for stabilization of their fractured femur. Bupivacaine plasma concentrations of radial artery blood samples were assessed over a 6-hour period after a femoral 3-in-1 injection of 2 mg/kg bupivacaine 0.375% with epinephrine (1:400,000). No toxic reactions to bupivacaine were seen. In 8 of the 10 patients per- and postoperative analgesia were adequate as a result of the nerve block. Patients experienced loss of sensation and analgesia for 26.6 +/- 4.6 hours. This was inversely related to the apparent steady state concentration of bupivacaine. The mean of the individual peak plasma concentrations of bupivacaine

(C(max) was 0.74+/- 0.64 mics/ml. The highest plasma concentration was 1.83 mics/ml. A femoral 3-in-1 nerve block, using 2 mg/kg bupivacaine with epinephrine, provides prolonged pain relief without local anesthetic toxicity in elderly patients.

7. **Anker-Moller E** in 1990 did a comparison study to analyze the plasma concentrations and analgesic effect of bupivacaine 0.250% and 0.125% following continuous blockade of the lumbar plexus after knee surgery. In 20 patients a continuous block of the lumbar plexus was administered after knee-joint surgery and the analgesic effect of two different concentrations of bupivacaine was compared. The same volume of bupivacaine was given to both groups of patients: a bolus dose of 0.4 ml/kg, 0.5% or 0.25%, followed by infusion of 0.14 ml/kg/h, 0.25% or 0.125%, respectively, via a catheter placed in the neurovascular fascial sheath of the femoral nerve according to the "3-in-1 block" technique. All plasma concentrations were below 4 micrograms/ml, the highest concentration measured being 3.6 micrograms/ml. It is concluded that when used for a continuous block of the lumbar plexus after knee-joint surgery, bupivacaine in a concentration of 0.125% offers the same pain relief as a concentration of 0.25%, and the risk of toxic reactions is reduced.

8. **Morau D, Lopez S, Biboulet P** of the Department of Anesthesiology and Critical Care Medicine, Lapeyronie University Hospital, Montpellier, France evaluated the efficacy and technical aspects of continuous 3-in-1 and fascia iliaca compartment

blocks. Forty-four patients scheduled for cruciate ligament repair or femur surgery were randomly divided into 2 groups. After surgery with the patient anesthetized, catheters were placed for continuous 3-in-1 blocks by means of a nerve stimulator (group 1). In group 2, the catheter was inserted for continuous fascia iliaca compartment block without the use of a nerve stimulator. In both groups, a 5-mg/kg bolus of 0.5% ropivacaine was administered followed by continuous infusion of 0.1 mL/kg/h of 0.2% ropivacaine for 48 hours. In both groups, the distribution of the sensory block and its course were similar except for those of the obturator nerve (more sensory blocks in group 1, $P < .05$). No significant difference was noted between the groups regarding median VAS pain values and consumption of morphine during the 48-hour period.

9. **Winnie AP, Ramamurthy S, Durrani Z.** The inguinal paravascular technic of lumbar plexus anesthesia: the "3-in-1 block". In their study the 3 in 1 block was performed by the double popoff method and was found to be successful in providing pain relief. *Anesth Analg* 1973; 52(6): 989-96.

10. **Khoo ST, Brown TC.** Femoral nerve block--the anatomical basis for a single injection technique. In their study the femoral nerve block was done on the basis of the two fascia covering the Femoral nerve. *Anaesth Intensive Care* 1983; 11(1): 40-42.

11. **Hirst GC, Lang SAA** in 1996 conducted double-blind, randomized, controlled

study of 33 patients undergoing total knee arthroplasty, who were randomized into three groups. Group 1 received a single-injection femoral 3-in-1 nerve block with 20 mL 0.5% bupivacaine with 1:200,000 epinephrine. Group 2 had a catheter placed in the femoral nerve sheath, through which a continuous femoral 3-in-1 nerve block was established. Group 3 patients served as controls who received systemic analgesia with morphine given by Patient Controlled Analgesia. In the recovery room, pain scores with motion were lower in the single-injection and continuous-infusion groups ($P < .05$) in comparison to the control group.

MATERIALS AND METHODS

Study Design

This is a cohort study.

This study was conducted at Government Rajaji Hospital, attached to Madurai Medical College, Madurai. Fifty patients ASA I / II physical status who got admitted in trauma ward for fracture femur with no other injuries were taken into consideration. All these patients were resuscitated along with the primary and secondary survey. Informed consent was obtained and visual analog scale explained. Those patients with multiple injuries, who refused regional anaesthesia, those with dementia were excluded from the study.

Procedure:

Drugs and equipments for resuscitation were kept ready. After establishing an intravenous line, patient was positioned as necessary for “3 in 1” nerve block. Under strict aseptic precautions local anaesthetic solution was prepared and all the equipments needed like tuohy needle, 16G epidural catheter, G pad and plasters were kept ready.

“3 in 1” nerve block was performed on the side of injury under strict precautions using double popoff technique. 18G epidural catheter is threaded through the Tuohy needle into the appropriate space and catheter was fixed in position. During the

performance of block, the time taken for performance of block, procedure details like double pop off, pulsation, paraesthesia, muscle twitching were noted. After identification of space by Double Popoff method about 30ml of 0.375% bupivacaine was injected through the catheter. From the performance of block the onset time for blockade of sensations like temperature, pinprick and pain due to movement were noted. Visual Analog Scale was used for both preblock assessment and postblock assessment. Complications such as vascular injury, systemic toxicity and infection were taken into account.

The visual analog scale that was used to assess the extent of pain in the preblock period and to assess pain relief in postblock period.

After the performance of block the nerves that were blocked were assessed by checking their dermatomal supply. Any motor block that was noticed was also made into account.

After the block had taken, the fracture segments are immobilized by Upper Tibial Pin Traction with Thomas splint. The Visual Analog Scale was assessed every 4 hrs after performance of the block. When the Visual Analog Scale dropped to 5 or less, it was taken as the duration of pain relief. Following which local anaesthetic Bupivacaine 0.125% 20ml was injected through the epidural catheter was given. This was repeated whenever the VAS dropped to 5 or less for 48hrs after the performance of block. The number of top-ups that was required for each and every case was noted. After 48hrs the epidural catheter was removed and further pain relief if needed was given by means of systemic analgesia.

OBSERVATIONS AND RESULTS

The onset of sensory block for temperature sensation is 1-10 mins (2.62-1.57). Abolition of sensation to pinprick took 2 to 15mins (5.25-2.36). There was no pain to movement of fractured limb at 7 to 30 mins (11.14-3.98).

The VAS scale recorded after the performance of the block is 1-4 (2.17-0.76).

The time for first topup ranged from 6 to 14hrs (9.89-1.66) and the number of topups required was 4 to 9 (6.11-1.73).

Out of the 40 blocks that were performed 31 had taken completely and 4 blocks had partially taken with sparing of lateral cutaneous nerve of thigh. 5 blocks had not taken completely.

Block was considered failed if no pain relief to pinprick even 30 mins after the performance of the block. The success rate of the block was complete 77.5%, partial was 10% and failure rate was 12.5%.

The time required for performance of the block ranged from 5 to 13 mins (7.03-2.01).

Of the 40 blocks that were performed, popoff was noted in all cases (100%), 25 cases had transmitted pulsation (62.5%), paraesthesia was noted in 3 cases (7.5%) and twitch was noted in 2 cases (5%).

Complication that was noted in my study was vascular injury involving the

femoral artery which was managed with tight compression for few minutes. The incidence of vascular injury was 4 Of 40 cases(10%). No other complications were noted in my study.

AGE DISTRIBUTION

AGE RANGE (YRS.)	MEAN \pm S.D.(YRS.)
39 TO 84	64 \pm 12.09

ONSET OF SENSORY BLOCK

SENSORY BLOCK	MEAN \pm S.D.(MINS)
TEMPERATURE	2.62 \pm 1.57
PINPRICK	5.25 \pm 2.36
MOVEMENT	11.14 \pm 3.98

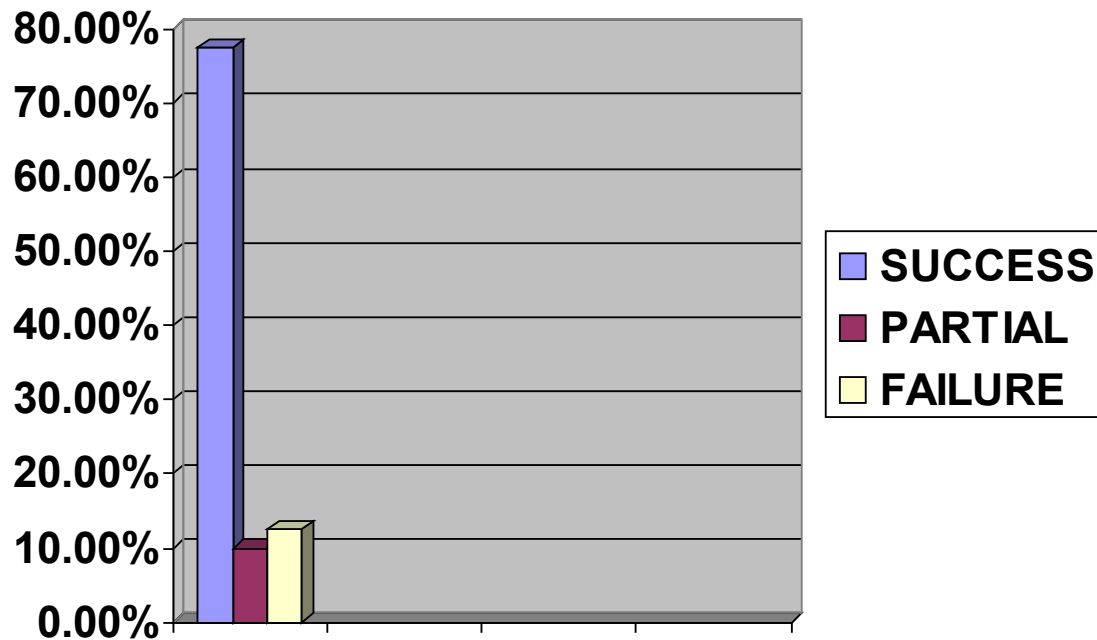
AS SCALE	MEAN \pm S.D.
	2.17 \pm 0.76

DURATION	MEAN \pm S.D. (HRS.)
OF ANALGESIA	9.89 \pm 1.66

TOP-UPS	6.11 \pm 1.73
TIME FOR PERFORMANCE	7.03 \pm 2.01 MINS

COMPLICATIONS	VASCULAR INJURY
RATE	10 %

SUCCESS RATE OF THE BLOCK



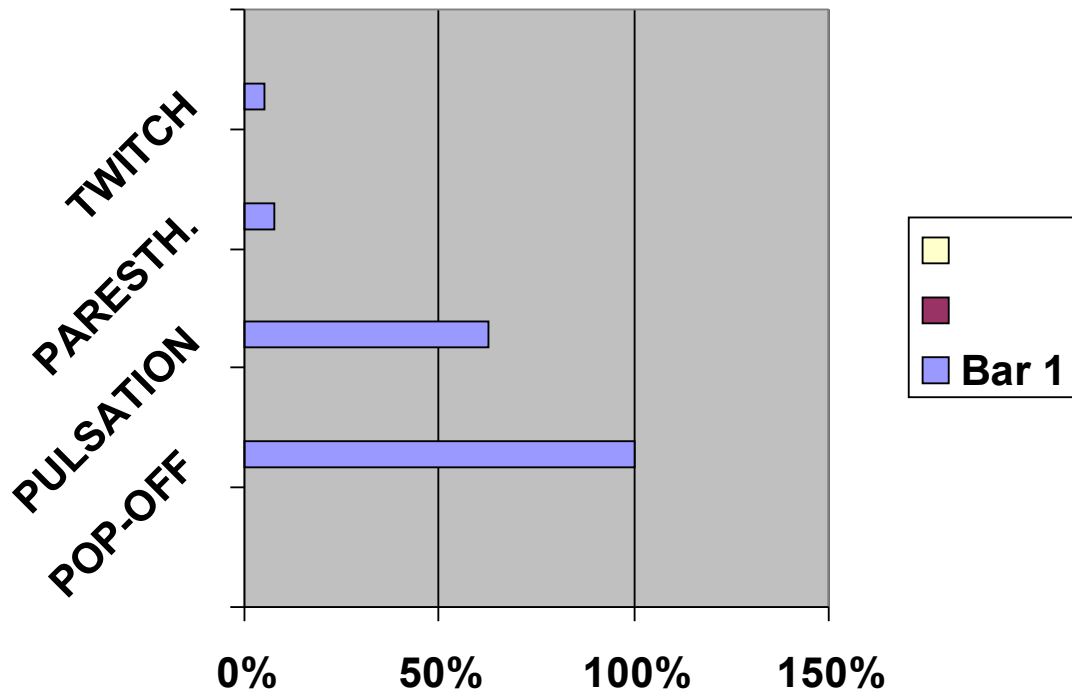
SUCCESS RATE- 31 OF 40 CASES---77.5%

PARTIAL

BLOCK RATE- 4 OF 40 CASES--- 10%

FAILURE RATE- 5 OF 40 CASES---12.5%

PARAMETERS OF THE BLOCK



POP-OFF -- 40 OF 40 CASES – 100%

PULSATION -- 25 OF 40 CASES – 62.5%

PARAESTHESIA -- 3 OF 40 CASES - 7.5%

MUSCLE TWITCH -- 2 OF 40 CASES - 5%

DISCUSSION

Fracture femur is one of the common injuries that occur in the elderly age group patients following trivial injuries. These patients contribute significant number in trauma ward. Provision of analgesia is an important component of successful management of these patients.

The inguinal paravascular approach of lumbar plexus is used to provide analgesia for fracture femur as it blocks 3 nerves namely Femoral nerve, Lateral cutaneous Nerve of thigh and Obturator nerve which supplies major part of thigh. In this study the 3 in 1 block is done using epidural needle by double popoff method without the use of nerve stimulator or paraesthesia. This double popoff method is based on the concept that femoral nerve is covered by two fascias namely fascia lata and fascia iliaca. By this approach the lumbar plexus is reached as it also lies beneath between fascia lata and iliaca.

In this study the efficacy of 3 in 1 block technique by double popoff method was tested and it was found that it produced success rate of 77.5% when double popoff is clearly felt. Transmitted pulsation was noted in 62.5% , paraesthesia noted in 7.5% and muscle twitching were noted in 5% of cases. In the study done by Edwards and Wright

et al femoral nerve block was done with the Tuohy needle with double loss of resistance without the use of nerve stimulator. This study had good result in producing analgesia. This double popoff method also formed the basis for the study conducted by A.P.Winnie, Ramamurthy and Durrani in 1973. Based on this anatomical basis Khoo and Brown did the single injection technique of femoral nerve block..

The continuous 3 in 1 block provided excellent analgesia to any movements with significant reduction in VAS scale. The VAS scale after the performance of the block in my study was 2.17 ± 0.76 . In the study done by Capdevila, Biboulet et al the VAS scale was found to be less than 2.

Also in the study done by Fletcher, Rigby et al and Haddad and Williams the 3 in 1 block was effective in providing good pain relief in fracture femur cases admitted in the Emergency Department.

The duration of pain relief was 9.89 ± 1.66 hrs. In the study done by Fournier, Van Gessel et al the duration of analgesia was noted to be 8.2 ± 0.67 hrs. The analgesia was extended for first 48hrs after the block using epidural catheter that was threaded into the space. In the study done by Edwards and Wright continuous block was obtained by means continuous infusion of 0.125% bupivacaine at 6ml/hr using infusion pump. As there is no infusion pump in our centre , the continuous blockade was achieved by intermitted topup injection with 0.125% bupivacaine 20ml through the catheter. The

number of topups required during the first 48hrs was 6.11 ± 1.73 . The topups were given when the VAS scale was 5 or less which was periodically assessed every 4hrs after the performance of the block. This method was effective in providing pain relief for 48hrs after performance of the block.

In my study the complication that was observed was the vascular injury involving the femoral artery which was managed by compression over the injection site. No toxic reaction to bupivacaine was noted. In the study done by Snoeck and Vree with 2mg/kg of bupivacaine for femoral 3 in 1 block in patients older than 80years of age, the mean peak plasma concentration of bupivacaine was noted to be 0.74 ± 0.64 mics/ml. The highest peak plasma concentration was 1.83 mics/ml which is well below the toxic concentration. In the study conducted by Anker- Moller, continuous blockade of lumbar plexus was achieved with 0.4ml/kg of bupivacaine. The plasma concentration was below 4 mics/ml and the highest plasma concentration was 3.6mics/ml. Both these studies show the safety of the continuous 3 in 1 block with respect to bupivacaine dose.

The use of continuous 3 in 1 block with inguinal paravascular approach provided good analgesia for fracture femur cases even without the use of nerve stimulator. With practice the double popoff method can be efficacious in providing analgesia for the needed in the trauma ward.

SUMMARY

Forty patients admitted in the trauma ward with fracture femur were given trauma analgesia using the inguinal paravascular approach of lumbar plexus. Double popoff method was utilized for the performance of the block. This block produced 77.5% success rate. Initial pain relief was given using 0.375% bupivacaine 30 ml. Subsequent pain relief given using 0.125% bupivacaine through the epidural catheter. This block provided substantial pain relief to these patients.

CONCLUSION

Thus the continuous 3 in 1 nerve blockade of the lumbar plexus can be performed by the double popoff method with high success rate and with minimal complications in patients with fracture femur. This block not only provides substantial pain relief but also prevents the stress response to pain in the trauma patients and hence justifying their use in trauma patients.

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CONTINUOUS 3 IN 1 BLOCK FOR PAIN RELIEF FOR
TRAUMA PATIENTS WITH FRACTURE FEMUR

NAME: AGE/SEX: I.P.:

DIAGNOSIS: DOA:

PAIN RELIEF: 3 in 1 block done
Using 16g epidural needle with 18g epidural catheter

PROCEDURE:

DRUG: 0.375% BUPIVACAINE 30ML given

ARRIVAL → BLOCK PERIOD:

ONSET TIME--- TEMPERATURE :
PIN PRICK :
MOVEMENT :
PAIN SCORE VAS :

ANY MOTOR BLOCK :

NERVES BLOCKED:

NERVES SPARED :

DURATION OF PAIN RELIEF :

TOP-UPS :
TILL 48HRS.

PROCEDURE – RELATED:

TIME TAKEN FOR PERFORMANCE:

DOUBLE-POPOFF --

PULSATION --

PARAESTHESIA --






MUSCLE TWITCHING –

COMPLICATIONS:

VASCULAR INJURY:

SYSTEMIC TOXICITY:

INFECTION:

	Scale	
No pain	0	
	1	
Mild, annoying pain	2	
	3	
Nagging, uncomfortable, troublesome pain	4	
	5	
Distressing, miserable pain	6	
	7	
Intense, dreadful, horrible pain	8	
	9	
Worst possible, unbearable, excruciating pain	10	